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A Guide to Monetary Measures of Soviet Defense Activities

A Reference Aid

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November 1987

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A Guide to Monetary Measures of Soviet Defense Activities

Summary

Information available as of 1 October 1987 was used in this report.

The Soviet Union equips and maintains a massive military establishment. Over the years, many measures have been developed to provide summary impressions of its size and the resources diverted to it from civilian uses. One set of measures frequently used consists of placing a price on each component of the annual activities required by the military forces. Such measures are collectively called monetary measures. They differ among themselves by the type of prices used.

Monetary measures have proved useful for measuring the economic costs to the Soviets of their military and for measuring aggregate trends in the size and composition of their forces. They are also used to compare the size and economic impact of the Soviet forces with the defense effort of the United States. They are ill suited, however, for addressing such important issues as the military effectiveness of the forces.

The simplest monetary measure of Soviet forces is the amount of rubles shown in Soviet records as being spent on them. This measure, called current ruble prices, is flawed for two major reasons. First, annual changes in spending levels reflect both inflationary effects and "real" changes in the goods and services purchased. Because inflation in Soviet total defense spending averaged an estimated 3 percent per year during the 1970s, this current ruble measure of spending exaggerates "real" growth by the same amount. Second, because of the way Soviet prices are regulated by central authorities, the official prices are distorted reflections of actual resource costs.

The other monetary measures in common use have their own strengths and weaknesses. The Soviets have a measure, called *comparable ruble* prices, designed in part to eliminate inflationary effects. Western experts have developed two so-called constant price measures. One, called *constant resource* prices, attempts to eliminate both inflationary effects and distortions in the price of an item from its "real" costs. The other, called *constant output* prices, also attempts to eliminate inflation effects but bases the price of an item on a "standardized" cost for the item. Finally, Western experts have developed the concept of factor cost, which adjusts any of the above Soviet or Western measures to a set of prices based on the factors of production—land, labor, and capital—used in producing the goods being measured.

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The definitional distinctions among the different measures are sometimes difficult to understand and to apply, but the resulting measurements of Soviet defense activities over time can differ significantly. The proper measure to use depends on the issue being studied and on whether one is seeking a Western or a Soviet perspective on the issue. A summary to choosing an appropriate measure follows:

Question	Point of View	
	Soviet	Western
How much have the Soviets been spending on defense?	Current ruble prices	Current ruble prices
What are the trends in Soviet defense spending?	Comparable ruble prices	Constant ruble resource prices
What are the trends in the volume of goods going to Soviet defense?	Comparable ruble prices	Constant ruble output prices
What has been the impact of defense on the Soviet economy?	Comparable ruble prices	Current or constant ruble resource prices at factor cost
What are the trade-offs between defense and the civilian economy?	Current ruble prices	Current ruble prices at factor cost
Where have the Soviets been putting their resources within defense?	Comparable ruble prices	Constant ruble resource prices

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A Guide to Monetary Measures of Soviet Defense Activities

Introduction

This paper is intended to acquaint the reader with the considerations involved in choosing a monetary base for valuing Soviet defense activities. The paper is tutorial in nature, simplistic in some respects, and not intended to be either definitive or an official presentation of intelligence estimates. It focuses on the concepts behind the measures rather than on the methods of data collection and calculation.[1]

The Soviet Union engages in a host of defense activities.[2] Some of the activities add new weapons to military forces. Others furnish and train military personnel. Still others provide new technologies, keep equipment in good repair, and support Soviet policy objectives. The complexity of these activities makes it difficult to grasp the magnitude of the effort involved, identify trends in the size of various categories of activity, or compare Soviet activities with similar US activities.

Summary measures are needed that are comprehensible, yet capture the important aspects of the underlying activities. Monetary measures are among the more useful of such measures. A monetary measure can be calculated by assigning a cost to each activity and then summing over all the activities of interest. Different measures of the same set of activities can be obtained by choosing different kinds of prices to represent the costs.

[1] A more detailed explanation of Soviet pricing practices, factor costs, and some of the other concepts addressed in this paper is found in *USSR: Measures of Economic Growth and Development, 1950-80*, a volume of studies prepared by the Central Intelligence Agency in 1982 for the Joint Economic Committee of Congress.

[2] In this paper the term "defense" is used in the broad sense and includes both offensive and defensive forces. The term "military" might be preferred but for its historic association with army forces only to the exclusion of naval forces. The defense activities covered are about the same as the US activities funded by the Department of Defense. The paper focuses especially on the procurement of weapon systems for Soviet military forces. Procurement covers both the acquisition of weapons and equipment and their major, or capital, repair.

Monetary measures are not necessarily the best measures to use for all purposes. Other summary measures of Soviet defense activities range from total numbers of weapons to the results of elaborate war games. In general, monetary measures of the appropriate sort are most useful for:

- Displaying trends and changing emphases in resource allocations.
- Evaluating economic costs and impacts.
- Sizing the overall magnitude of output of dissimilar goods and services for comparison with output of another period or country.

Other measures are more appropriate and should be used for:

- Assessing the capabilities of military forces.
- Estimating the efficiency of defense industries.
- Judging the wisdom of the resource decisions.

This paper defines the major monetary measures of Soviet defense activities. It discusses their applicability for answering certain questions and illustrates their uses. The measures are for the general purpose of valuing the annual activities associated with providing Soviet military forces with weapons, equipment, supplies, and personnel and maintaining and operating those forces. After a selective review of the Soviet-administered price system, the methods of valuing these annual flows of goods and services to the Soviet military establishment are addressed.[3] The paper ends

[3] The paper focuses on the annual defense activities because they can provide good indicators of changing trends. They also show the intensity of adding new capabilities and the tempo of manning, maintaining, and operating the forces. They do not, however, measure the amount of equipment and supplies on hand. A measure of inventory or stock value is necessary for that. While superficially attractive, monetary measures of stock value have had little success for two reasons. First, meaningful depreciation rates have been difficult to find because the depreciated values need somehow to be tied to the remaining military value rather than some arbitrary accounting convention. Second, a stock value calculation is but a poor proxy for force measures of effectiveness and hence has limited utility.

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with a discussion of how monetary measures should be used to examine some of the issues often raised about Soviet defense activities. It will be shown that the proper measure to use will depend on the particular issue being analyzed. No single measure is best for analyzing all issues, but each measure is useful for some issue.

The Soviet-Administered Price System [4]

Soviet prices are based on production costs rather than on supply and demand in a market. The Soviets have a centrally administered price system. Wages and the prices for food, services, transportation, utilities, raw materials, and industrial goods are usually set by central authorities. Some important implications of Soviet pricing practices are well illustrated by looking at the wholesale prices of industrial goods. For most civilian products, once a price is set it is seldom changed before the next general price revision.[5] Prices of many industrial goods for the military, however, are subject to change each year.

Prices of Civilian Goods

When a new industrial product is introduced, the Soviets set a *temporary price* for it. This price covers the estimated costs of production plus profit margin.[6]

After the product has been in production for awhile, usually in its second year, a new price is set for it. This new price is called the product's *permanent price.* It is based on the same factors as the temporary price but is presumed to reflect better data.[7] These prices are published in price lists and are the prices the plant receives when it sells the product. Both the temporary and the permanent prices are called *established prices* in the West to distinguish them from the other ruble prices discussed later in this paper.

In principle, a product's established price is based on a prediction of its actual cost to produce. In practice, however, this objective is difficult to achieve. Even the cost of an item already in production is not easily determined by outside administrators. Product specifications and quality may suggest an approximate cost, but the detailed cost data are held and controlled by the individual plant or enterprise. The problem is compounded when outsiders try to estimate future costs.

Although plants report many cost figures to supervising agencies, the plant manager has considerable practical flexibility in allocating production costs to different accounts and products. Labor and material usage by product is difficult for an outsider to verify, and the allocation of overhead is inherently arbitrary. An outside administrator has little choice but to accept the plant's reporting on its cost breakdowns. Only the total plant costs can be reasonably monitored, and even they can be misleading.

Plant management, moreover, is prone to carry excess workers and to hold excessive stockpiles of material for future needs. The costs of these inefficiencies are recovered by the prices charged. There is little incentive for correct cost reporting. Indeed, the more the cost of a product can be inflated for purposes of getting a higher price, the easier it is for the plant to meet quotas for the value of its output and receive the resulting bonuses for plant managers and workers.[8]

[4] See Morris Bornstein, "The Administration of the Soviet Price System," *Soviet Studies,* vol. XXX (October 1978), pp. 466-90, and CIA Research Paper ER 79-100631 (Unclassified), December 1979, *An Analysis of the Behavior of Soviet Machinery Prices, 1960-73*, for a more complete discussion of the administration of prices in the Soviet Union. This section discusses the pricing mechanisms in practice over the past 20 years. There has been considerable talk of major pricing policy changes in the next few years.

[5] On occasion, the Soviet leadership decides that the relative price structure needs revamping, and they reset many of their prices either through a price reform—a change in the basic principles of price formation—or price revision—which entails changing many prices, but not principles. Major price changes were carried out in industry in 1955, 1967, and 1982, and in construction in 1969 and 1983. In addition to these major changes, there have been price changes in other years for large sets of prices, often for whole industrial branches.

[6] Planned profit rates are set in terms of percentages of costs or the value of fixed and working capital. The planned rate for a branch of industry will be based in part on policy objectives. For example, the profit rate on agricultural machinery is set at a lower level than the industrial average to obtain lower prices. The profits are distributed as contributions to the parent ministry and state, capital for plant investment, bonuses paid to management and labor based in part on meeting or exceeding quotas, and funds for worker housing and benefits.

[7] Nevertheless, in practice the temporary price often becomes the permanent price.

[8] A more subtle way of obtaining an unwarranted high price than by simply padding production costs is to claim a higher quality for a product than it actually has. Higher quality products not only implicitly cost more, but are frequently rewarded with a bonus price markup as an incentive to produce such products.

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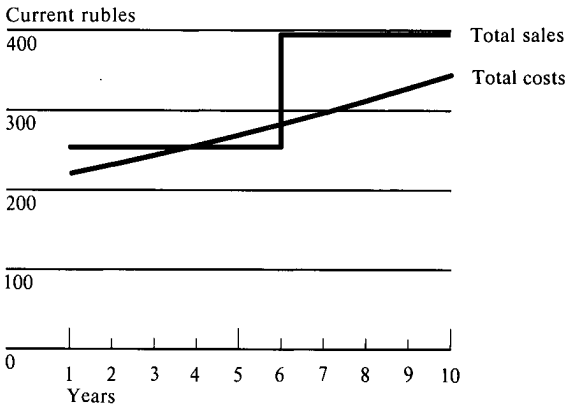
On the other hand, once a permanent price is set for a civilian product, it is rarely changed until a general price revision is carried out. But the costs of inputs to production, especially new equipment and labor, tend to rise over time in the Soviet Union as they do elsewhere. For some products, these rising costs of inputs are more than offset by reductions in the amount of inputs required, and the longer a product remains in production the more profitable it becomes.[9] In other cases, however, the input savings are small, and it becomes increasingly difficult for a plant to maintain its profit margin on old products. In these cases, plant managers need to establish the price of a new product as high as possible to maintain total plant profits at "acceptable" levels. This high price helps cover the losses on older products and provides a hedge against increased costs of production in the future (see figure 1).

The net effect of the Soviet pricing system is a distorted price structure from a cost perspective. For manufacturing processes that do not lend themselves to significant input reductions from learning, prices tend to be too low for products that have been in production for a few years and too high for products newly introduced. The practice of setting the price of a new product higher than its actual costs warrant is often called *new product inflation.* It will be a major factor in the discussions of the following sections. (An arithmetic example of how this kind of inflation can occur is presented in figure 1.)

As mentioned previously, the tendency for new products to have exceptionally high prices with respect to costs is caused only in part by concerns about profits. Plant management also has strong incentives to show

[9] Many manufacturing processes do allow a reduction over time in the amount of inputs used to produce a given product. This reduction, primarily in labor, is a well-documented fact in both market and centrally planned economies. As a good continues to be manufactured in the same plant, the plant managers and workers continue to find cheaper ways to produce the product. This learning is achieved through a wide variety of mechanisms including better organization of the assembly process, better handling of supplies, minor design changes to speed assembly, and so forth. Costs are reduced because fewer inputs are required as this learning takes place. The cost reduction is usually summarized analytically by a learning curve that shows the expected cost of a particular unit as a function of the number of units of the same product previously produced. These cost reduction, or learning, curves do not reflect any changes in input prices.

Figure 1
Inflation In Costs and Sales Prices



The joint effects of rising costs and the Soviet price system are illustrated. The data are based on the hypothetical production of a plant over a 10-year period. Three different products are produced, each having a production run of 10 years and each requiring the same amount of resources. The first product begins production five years before the period shown and continues for five years into the period. The second product begins production at the start of the period and continues throughout. The third product begins production in the sixth year of the period, replacing the first product. Each product is produced at the same constant rate so the total numbers produced and the actual resources consumed are the same in all years. The total cost of the resources used, however, increases by 5 percent each year. The cost line shows the increasing annual costs, less profit, of producing these products. The price of each product is set when it enters production and is not changed. The price for the new products are set so the average profit from ***all*** *sales is 15 percent of costs for both years 1 and 10, resulting in each of the products having a price 55 percent higher than its predecessor. The sales line shows the total amount received for the products. This amount changes only in the sixth year when the new product is introduced. The new product price compensates for the increasing loss of profit on the older goods and provides a cushion for future rising costs. In this example, the result is an inflation rate of 9 percent per year even though the exercise specifically assumes that there is no improvement in product quality that would justify a higher price.*

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growth in the ruble value of the plant's output. The higher the price placed on a particular good, the higher value a given quantity of production will have. Because the advantages cited require the introduction of a new product, there is an added incentive to introduce new products, particularly ones similar enough to existing products that little risk is involved. Moreover, the benefits of introducing a new product do not accrue solely from its price. The Soviet practice of calculating growth in output from one year to the next by linking annual growth only of those products in production in both years can, in certain circumstances, result in growth rates even higher than the actual growth in the total value itself.[10]

Prices of Military Weapons

The preceding discussion applies to the pricing of Soviet military weapons as well. There is, however, an additional consideration that deserves special attention. Military representatives at each defense plant monitor production and inspect for quality. These representatives also negotiate each year with plant management to reset the established price of a product. Unlike the general civilian case, the price of the military good can be changed each year.[11]

In the negotiations, the plant manager would argue for keeping the price constant or, more likely, raising it to cover increasing costs. The military representative would counter that the price should be lowered as the plant learns to produce the product more efficiently. The actual price set in a year is determined by the relative bargaining strengths of the two sides. The military representative has access to the plant's books and can accept or reject the plant's production. The plant manager controls what is in the books and has many ways to delay production of a product that the military wants if he is not satisfied with the price set. Figure 2 shows the kind of information that would be brought to bear during the bargaining process.

The incentive for the plant manager to obtain a high initial price for a new military product is greater than for a civilian product. Unlike the civilian case, the price of a military product can be forced down. Producers of military goods cannot count on the cushion of profit enjoyed by producers of civilian products that maintain fixed prices but experience learning cost reductions. The higher the initial price obtained, then, the more the manager can absorb both price reductions and cost increases.

Ruble Measures

The preceding section outlined how established prices are set in the Soviet Union. This section discusses how these prices, and prices based on them, are used to provide monetary measures of Soviet defense activities. It begins by presenting two measures the Soviets probably use. It then discusses measures developed by Western experts.

Soviet Measures

The Soviets keep secret all aspects of their defense activities, including costs. Although they publish a single annual number that purports to be their defense budget, it is far too low to be credible and the Soviet leadership undoubtedly uses other numbers. Soviet data for their civilian activities are often measured using either *current* rubles or *comparable* rubles. It seems reasonable that the Soviets would also use these measures for their defense activities.

[10] Consider the simple case in which a plant produces two products within a three-year period—the first product in annual values of 100, 90, and 0, and the second product in annual values of 0, 10, and 100. The total annual values are 100 in each year, showing no growth. Because the second product was not in production the first year, the linked value method would count only the first product and show a negative growth from the first to the second year of −10 percent (100 dropping to 90). The growth calculation from the second to the third year, however, would count only the second product because the first was no longer in production in the third year. This calculation would show a staggering 900-percent growth (10 to 100) for a linked growth rate from the first to the third year of 800 percent—(100) (.9) (10) − 100.

[11] See P. V. Sokolov, *Political Economy: Socialism—The First Phase of the Communist Method of Production* (Moscow: 1974, JPRS 63693-2 translation, 17 December 1974), pp. 287-8, and The BDM Corporation, *Defense Industry Studies Monograph Series: The Role of the Military Representatives in the Soviet Defense Industry—A Case Study of the 3896th Military Representative Group (MRG) in Riga*, May 1981.

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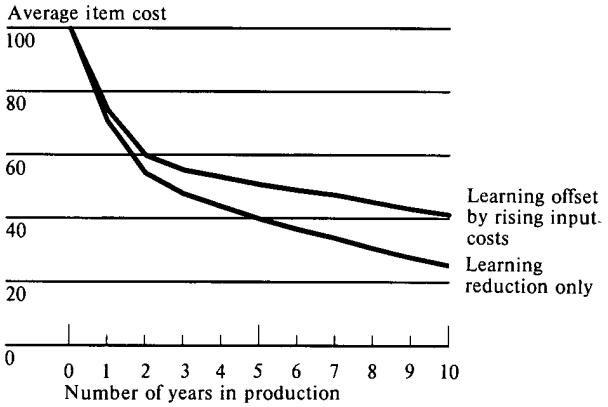
Figure 2
Changing Production Costs Over Time



The lower curve shows the effect of typical learning cost reductions over the course of a hypothetical production run. The cost reduction is calculated from the numbers produced and then translated to the time scale. The military representative might argue prices should be lowered to reflect these reductions. The plant manager might counter with tales of rising costs. The upper curve represents a possible compromise. It shows the learning reduction augmented with a nominal 5-percent annual increase to cover the claimed rising costs of running a plant. The cost reduction from learning is calculated for a hypothetical production schedule and rate of learning. A change in either would produce a different curve.

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Ruble Value in Current Established Prices. One can envisage a set of books in the Soviet Union that records all goods and services produced in a given year and the prices paid for each. The total value recorded would be in the established prices of the given year. A series of such totals over time would reflect both the differing quantities received and their changing official prices. Such a series is called a current ruble value series in established prices, or *current rubles* for short.

Current rubles are useful for gaining insights into how the Soviets might view their own spending. The Soviets recognize that current ruble prices do not always reflect actual costs and may also distort trends in physical output. Yet they have little choice but to do much of their basic data collection in current rubles, and budgets are set in current rubles. Current rubles also help in understanding changing economic conditions. Relative costs change as raw materials become more difficult to extract, capital and labor productivities change at different rates among sectors, and investment requirements vary. Monetary measures using current ruble prices, with all the imperfections discussed in the previous section, do capture to some degree these changing relationships.

Measures using current rubles, however, do not provide reliable indicators of trends in the magnitude of goods and services being produced. General price levels have been rising in the Soviet Union as in most countries. Current ruble series reflect both the changes in the volume of goods and services and changing price levels. When prices are generally rising, then, a current ruble series will exaggerate growth in the volume of goods and services produced. Figure 3 shows the magnitude of Soviet weapon systems procurement measured in current rubles. With this measure, one sees a general unbroken upward trend from 1972 through 1980 in the amount the Soviets paid to equip their military forces.

Ruble Value in Soviet Comparable Prices. The Soviets recognize that their current ruble series are not good indicators of "real" trends because the prices assigned to goods also reflect changing price levels. Their remedy is to compile much of their economic data in comparable prices. These prices are set for some base year and then held constant during an extended time period. The Soviets usually pick the base year to be the year of the most recent major price

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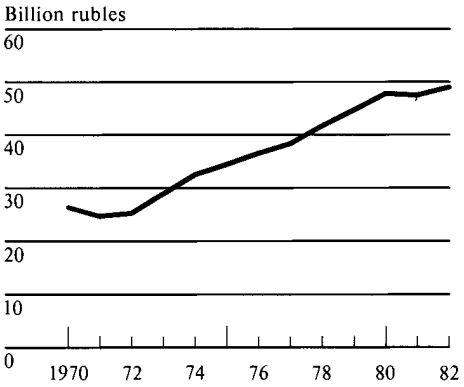
Figure 3
Soviet Military Procurement in Current Rubles



The line shows the annual value of goods procured for the Soviet military in current established prices. These prices represent the state set prices for the goods and include the effects both of inflation and the vagaries of the Soviet price-setting system.

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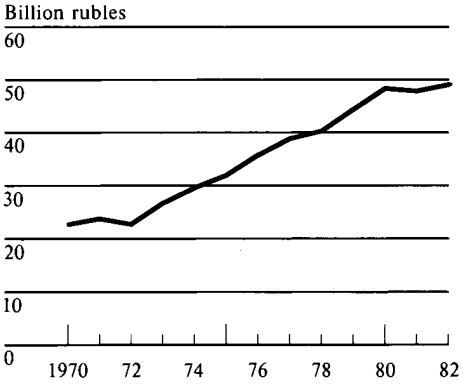
Figure 4
Soviet Procurement in 1982 Comparable Rubles



The line shows the annual value of goods procured for the Soviet military in Soviet comparable prices. These prices are based on the state set prices paid for goods in 1982 as explained in the text. Although the Soviets often refer to these prices as if they were "constant," they are conceptually quite different from Western constant prices. Comparable prices include most of the effects of inflation and reflect the vagaries of the Soviet price-setting system.

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revision. Once the base year is fixed, comparable prices are set for each good by assigning a value as follows: [12]

- For goods in production in the base year, the value assigned is the current established price of that year.
- For goods not yet in production in the base year, the value assigned will be the first permanent price for the good, although as noted earlier—the temporary price sometimes becomes the comparable price.

[12] In practice the Soviets do not calculate their comparable value series by actually assigning a comparable price to each item. The task would be too difficult and time consuming. Instead, many value series in current rubles are converted to comparable rubles by means of price indexes constructed for a sample of goods whose comparable prices are set in the manner discussed. This use of indexes introduces some unknown amount of error.

Figure 4 shows the magnitude of weapon systems procurement in comparable rubles with a base year of 1982.[13] The trend is similar to the trend in current

[13] The Soviets calculate the comparable values for years prior to the base year by "linking" to an earlier based series. During the period covered in this paper, the Soviets have used 1967, 1975, and 1982 as base years. The 1967-based series was calculated through 1975 and then dropped. The 1975-based series was dropped after 1982. Each product group has two comparable values for the year the base is changed, one in the base being retired and one in the new base. The ratio of these two values is used to extend the new base series backward. For example, the 1982-based comparable price value for the year 1979 is found by multiplying its 1975-based comparable price value by the ratio of the 1982 based value for the year 1982 over the 1975-based value for the year 1982, or

$$\Sigma P_{82}Q_{79} = \left[\frac{\Sigma P_{82}Q_{82}}{\Sigma P_{75}Q_{82}}\right] \times \Sigma P_{75}Q_{79}.$$

This process was used to obtain the comparable values in this paper.

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rubles shown in figure 3. A comparison of the two trends implies an average annual decline in procurement prices of more than 1 percent. (This comparison is discussed below and shown in figure 10.)

The Soviets use comparable value series to measure growth in output and productivity trends.[14] When applied in the Soviet system, however, the comparable price measure overstates actual growth and understates the increases in general price levels. This bias occurs for two main reasons. First, most of the inflationary rise in costs is absorbed in the prices of new products rather than in the prices of all goods produced. For example, if in a given year two products of an enterprise require the same amounts of resources to produce and are of the same quality, but one started production several years after the other, the newer product would generally have a higher price. As a result, new product lines are assigned a relatively higher comparable price than older product lines. In this respect comparable prices are similar to current prices and do not adequately adjust for changes in price levels.

Second, established prices for many defense industry products are reduced to reflect the cost reductions connected with learning. For these goods, any that entered production before the base year and continued through the base year will have a lower current price in the base year than in any earlier time. When their comparable prices are applied to output in earlier years, the resulting values are lower than the corresponding current ruble values. Similarly, goods entering production after the base year will have their comparable prices set before cost reductions from learning take place. The effect of this treatment of learning is to overvalue new production compared with old, thereby exaggerating growth. How the process can work in practice is illustrated in appendix B.

[14] The Soviets sometimes use comparable series to calculate implicit measures of changing price levels by forming the ratio of comparable price series to current price series. They also construct explicit price indexes by applying current prices to fixed samples of goods. The Soviet samples of goods are constrained to goods remaining in production throughout the period. This practice results in a downward bias as newly introduced goods with inflated prices are systematically excluded. Moreover, the Soviets sometimes lower the official prices on old goods that are claimed to be in production but in fact are not available.

Western Measures

Western experts have developed ruble-based measures designed to compensate for defects in the Soviet measures. The first to be discussed, values at factor cost, is of a slightly different character than other ruble measures. It is designed to be a better measure of the economic relationships among various sectors of the economy than Soviet established prices. Then two kinds of *constant price* measures are presented that improve on the Soviet comparable price measure by adapting concepts in common use in the West for measuring output over time.

Ruble Value at Factor Cost. The centrally administered Soviet price system inhibits setting the price of a product to reflect the opportunity costs of the resources used to produce it. The Soviets also, as a matter of policy, employ an elaborate system of subsidies and taxes to achieve certain objectives—distorting price relationships in the process. Therefore, using actual Soviet prices—whether current or comparable—as a basis for economic analysis can produce misleading results. A better representation of relative resource costs of producing different goods and services can be obtained by estimating prices at factor cost.

One can hypothesize an "ideal" economy with perfect competition, full use of all productive factors, and a mechanism that assigns to each product a price equal to its marginal value in the economy. In such an economy, each primary input factor—land, labor, and capital—receives a price proportional to the value of its marginal product. Each product's price will turn out to be the sum of the costs of the factors ultimately used to produce it. These ideal prices would be called prices at factor cost.

Such an economy can probably never exist in practice and certainly does not exist in the Soviet Union. But the notion of assigning prices to products proportional to their marginal value is attractive. Various methods have been developed for approximating factor costs in an economy. [15] Value series using factor costs can

[15] The Adjusted Factor Cost Standard method, pioneered by Abram Bergson, is commonly used for the Soviet Union. See Abram Bergson, *The Real National Income of Soviet Russia Since 1928*, Harvard University Press, 1961.

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either be calculated on a current basis, capturing the changing factor values, or be fixed for the factor values in a particular base year. Factor cost prices are generally used to measure the share of total output going to some component of GNP by end use. For example, the share of the Soviet GNP used for defense activities was 15 percent in 1982, using CIA's estimate of Soviet GNP at factor cost for that year.

Ruble Value in Constant Prices. If monetary values are to be used to trace changing patterns in defense activities, the values should be insensitive to general changes in price levels. [16] Changes in the values should reflect changes in the scale of the activities, not changes in economic conditions or pricing procedures. In the West *constant prices* are used to "remove the effects of inflation." These constant prices are calibrated to a specific base year. This section discusses two kinds of constant price measures:

- *Constant resource prices*, which are used to measure the cost of the activities that produce goods and services.
- *Constant output prices*, which are used to measure the volume of goods and services produced.

The constant resource price of a good is an estimate of what the good would have cost had it been provided under the economic conditions prevalent in the base year. The term "constant" refers to these fixed economic conditions. The constant resource price reflects the input costs, manufacturing technologies, and general productivities of the base year. The constant resource price for a given good can vary from year to year, however, as learning reduces the resources required to produce it.[17] In the West, the constant resource price for a good in the base year is its current price.[18] Because newer products for the military in the Soviet Union tend to have higher ratios of price to cost than older products, constant resource prices for Soviet goods in the base year are not necessarily their current prices.

Constant ruble resource prices are a Western construct.[19] The Soviets do not use them. Constant resource prices differ from Soviet comparable prices in three significant respects:

- The *comparable price* for a good not yet in production in the base year is taken to be the first permanent price given to it in the future. For a good no longer produced in the base year, an adjustment is made to its comparable price in a previous base year. These prices are necessarily based on the economic conditions of a different year than the base. *Constant resource prices* for goods not in production in the base year are explicitly tied to the base-year conditions.

- *Comparable prices* for those products whose costs fall because of learning are based on arbitrary points on the learning curve as discussed in the section on comparable prices. *Constant resource prices* are explicitly adjusted for these cost reductions. A product's constant resource price changes from year to year to reflect the reduction in resources required to produce it over time, but the prices of inputs and the general manufacturing productivities are those of the base year.

[16] General changes in price levels for defense goods should not be confused with the generally increasing costs of producing more modern weapon systems. Price level changes refer to changes in the average prices of the same set of goods or resources. Even if there were no change in the price level, the cost of producing more modern weapon systems would usually increase because each successive system tends to be more complex and to require more physical resources in production than its predecessor.

[17] This reduction in resources could be viewed as increased productivity, which might appear to contradict the assumption that general productivities are those prevailing in the base year. The distinction is between the overall productivity of an industry—which is assumed to remain constant—and the specific productivity achieved in producing a particular item—which is allowed to change. Learning in this context is often referred to as product-specific learning to separate its effects from the more general effects of changing industrial productivities.

[18] In the West, prices change frequently and the same good may have different prices from store to store and from locality to locality. The current price of a good in the base year should be understood to refer to an average of its various actual prices. Sometimes the base year is taken to mean the average prices in effect on some particular day of the year, such as 1 January or 1 July.

[19] In the West, constant prices are usually constructed by applying a price index of some sort to current prices. The Consumer Price Index is perhaps the most well known of these indexes. A price index is usually based on a carefully selected sample of goods. The changes in current prices for the goods in the sample are analyzed. Those changes reflecting changing quality are taken as "real" changes. All other changes are considered price level changes. The index is constructed to show only changes in the price level.

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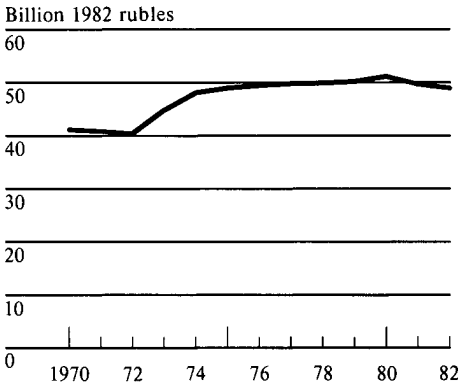
- *Comparable prices* are subject to the same distortions as current prices in the Soviet system. Prices for newly introduced products tend to be higher than they should [20] be compared with prices on older products from the same plant. *Constant resource prices* remove this differential in the base year in much the same manner as factor cost. For Soviet products, constant resource prices are an estimate of the actual base year costs plus profit. Constant resource prices are not necessarily the same as current prices in the base year.[21]

Figure 5 shows the magnitude of weapon systems procurement over time measured in the constant resource prices of 1982. Except for significant growth in 1973 and 1974, the measure shows little annual change in procurement. A comparison with the current ruble values in figure 3 shows that most of the growth in current value was the result of price levels rising by an average of 5 percent per year.

Constant resource prices are used to remove the effects of changing price levels on the *activities* required to produce goods. They are not designed to measure the volume of output. For this purpose, a price for an individual product should be fixed over time and prices for different goods should be in some justifiable relationship. Such prices are called *constant output prices*. If there were no cost reduction as a result of learning, constant resource and constant ruble output prices would be identical. With cost reduction, however, the constant resource price declines. One way to choose a constant output price is to select it at a predetermined point on the constant resource learning curve.[22] The only difficulty is picking the point. The average resource price over the second year of production appears to be as good a choice as any.[23]

Figure 5
Soviet Procurement in Constant Resource Rubles



The line shows the annual value of goods procured for the Soviet military in constant resource prices. These prices represent the levels of state set prices paid for goods in the base year 1982 and exclude the effects of inflation. They have also been adjusted to eliminate the vagaries of the Soviet price-setting system within a product group, but are still subject to distortions caused by unequal valuations of the factors of production across product groups.

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[20] "Should" in the context of the Soviet system, which attempts to set prices on a cost plus profit basis.

[21] This difference is not as significant in the West, where competition and free markets keep current prices in reasonable proportion to costs. On occasion, the Soviets implement a major price reform or revision to realign their prices. For a base year shortly after such a realignment, constant resource prices would be about the same as current prices for that year. Until recently, the CIA used 1970 as a base year. The major price reforms the Soviets instituted in the late 1960s were taken as having successfully balanced prices for weapon systems procurement. Recently, the CIA shifted its base year to 1982, the year of a major price revision. It is not yet known in the West if or how the Soviets adjusted the prices of their weapon systems in that year.

[22] Another common approach is to use the average constant resource price over the length of the production run. The disadvantage of this approach is that the resulting price is then a function of the length of the run. If two different plants independently produce an identical product, the constant output price should be the same for both no matter how much more one's production run exceeds the other.

[23] In both the Soviet Union and the West, a military good is often procured in a "lot" size equal to a year's production. A single price is negotiated for the lot, based on the projected average costs of production for the year. While the average costs for the first year of production are subject to all the uncertainties attending the start of new production and sensitive to the precise numbers produced, the average costs over later years tend to be more predictable.

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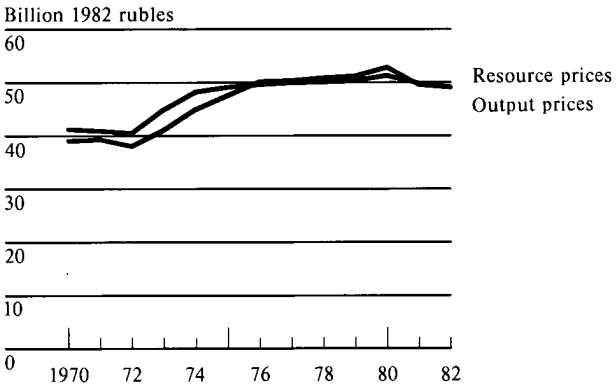
Figure 6
Soviet Procurement in Two Types of Constant Rubles



Two different measures of the annual value of Soviet procurement are shown. Both represent the levels of state set prices in the base year 1982, and both eliminate the vagaries of the Soviet price-setting system within a product group. The ***constant resource price*** *line reflects the individual products' cost reductions over time from learning. The* ***constant output price*** *line is based on the products' constant resource prices for the second year of production, normalized to the constant resource price total in 1982. The constant resource price series is a better measure of the production activities. The constant output price series is a better measure of the volume of output.*

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Figure 6 shows a volume measure of Soviet procurement in constant output prices. It was calculated by fixing the price for each product as its constant resource price in the second year of production. The resulting value series was then normalized so the total value was equal to the total value in constant resource prices for 1982.[24] Figure 6 also reproduces the constant ruble resource series of figure 5. Although the two lines are almost the same, each has different year-to-year growth rates. The greatest difference occurs in 1976, when the constant output price series shows a growth of 5 percent and the constant resource price series only a 1-percent growth.[25] The constant resource price series is a better measure of the resources used in production, the constant output price series a better measure of the volume of output.

Comparison of Ruble Measures

Figure 7 compares the current, comparable, and constant ruble resource values of procurement.[26] It suggests that the Soviets could well view trends in their defense procurement differently than do Western observers. When the Soviets look at their defense procurement using monetary measures, they use either current or comparable ruble values. They would see consistently high growth. Westerners studying Soviet procurement generally use constant resource ruble values. They see almost no growth after 1974.

The different implications of the three measures may be more clearly seen in figure 8. It indexes, or normalizes, the three ruble series to the year 1970 by dividing the values of each series by their respective values in 1970 and then multiplying by 100. Western experts believe the constant resource price series is the best monetary measure of the "real" cost of Soviet procurement over time. They believe the difference between the current series and the constant series represents only price inflation. The Soviets also prefer not to use current rubles as a measure of changing output magnitudes. They use the comparable price series for that purpose. By this standard, price levels are falling.

[24] The results are essentially the same if the prices are fixed at the third year instead of the second.

[25] On average, the two measures will produce the same growth rates. That is, sometimes one will show higher growth and sometimes the other, but neither one will consistently show higher growth than the other. Simulation of many hypothetical procurement profiles of about the same complexity as the Soviets' indicates that when the two measures are used to calculate annual growth rates, the two rates should be within 2 percentage points of each other about half of the time, and within 4 percentage points about 90 percent of the time. While extremely unlikely, differences as great as 25 percentage points can occur.

[26] The constant output price series is not shown because it is so similar to the constant resource price series.

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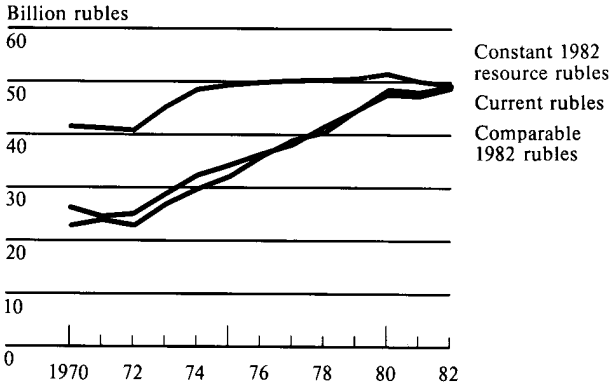
Figure 7
Soviet Procurement in Various Rubles



The three lines show the value of Soviet procurement as measured by three different types of ruble prices. The ***current*** *line represents procurement in the established prices of each year. It is the only line representing actual financial transactions. The* ***comparable*** *line shows procurement revalued for all years as the Soviets do when they revalue using the established prices of 1982. The* ***constant*** *line shows procurement revalued for all years using the concept of constant resource prices based on the general price levels in the Soviet Union in 1982.*

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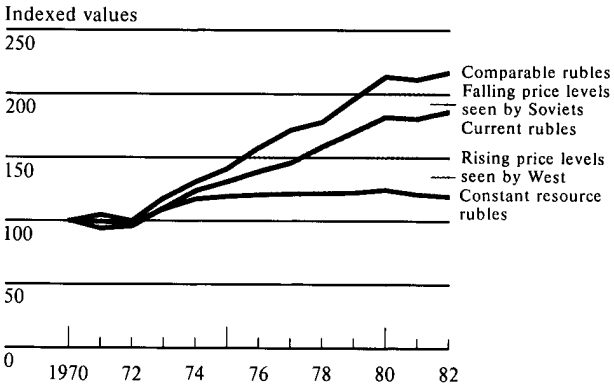
Figure 8
Soviet Procurement in Various Rubles Indexed to 1970



The three lines show the value of Soviet procurement measured by three different types of ruble prices and indexed so 1970 has a value of 100 for each series. The ***current*** *line, based on the established prices of each year, shows the annual amount the Soviets paid as a percent of what they bought in 1970. The* ***comparable*** *line shows how the Soviets would view their output for procurement increasing from 1970. They would see the difference between the comparable and current lines as representing falling price levels for procurement goods. The* ***constant*** *line shows how Western experts view the "real" cost of Soviet procurement. The difference between the constant and current lines represents rising price levels by Western standards.*

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Figure 9 shows the contrast in Western and Soviet measures of price level change by presenting two price indexes for Soviet defense procurement. Each price index purports to measure price level change. One is based on Western constant resource prices, the other on Soviet comparable prices. As previously noted, the Western measure shows inflationary rises, and the Soviet measure shows deflationary decreases.

The Soviets themselves are skeptical about the ability of their comparable price series to measure "real" growth. Published articles criticize the official data as exaggerating growth in the civilian economy.[27] It is

[27] See, for example, V. Selyunln and G. Khanin, "Cunning Figures," *Novyy mir*, No. 2, February 1987, pp. 181-201.

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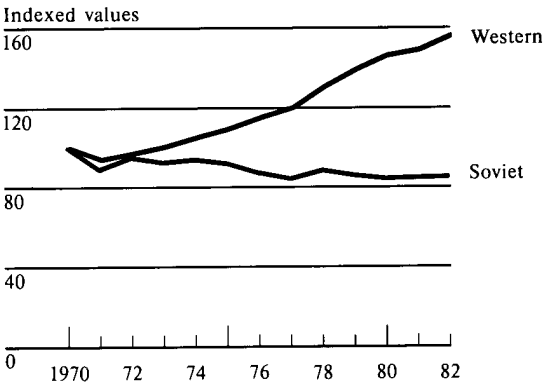
Figure 9
Two Price Indexes for Soviet Procurement



The two lines show price indexes for Soviet procurement normalized to 1970. The Soviet line is based on the ratio of current rubles to comparable rubles. The Western line is based on the ratio of current rubles to constant resource rubles. The Soviet line shows price levels declining by an average of 1 percent per year. In sharp contrast, the Western line shows price levels increasing by an average of 5 percent per year. The decrease in the Western line in 1971 is an anomaly that occasionally occurs with Paasche indexes. (Two types of price indexes are commonly used. One is called Laspeyres, the other Paasche. Their basic difference lies in the treatment of the quantities used to weight the prices. Laspeyres indexes keep the quantities fixed, Paasche indexes vary the quantities each year. The indexes shown in this figure are Paasche type. The anomaly in Paasche price indexes is that the index can show falling price levels for a year in which all individual prices rise. A simple example will illustrate the point. Consider an index for just two products with base year prices of 10 and 20. For two consecutive years of the series, suppose the first product has quantities of 100 each year with current prices of 20 and 21, and the second product has quantities of 50 and 500 with current prices of 30 and 33. Then the current values for the two years are 3,500 and 18,600. The constant values are 2,000 and 11,000, yielding index values of 175 and 169.)

not known in the West how the Soviet leadership view their defense procurement trends. All data relating to defense are carefully controlled. Still, it is difficult to believe the Soviets would measure defense growth with a monetary method different from that used for the rest of the economy.[28]

The comparison of ruble measures has focused on Soviet procurement as an example, but the measures produce different values for the other defense activities as well. Figure 10 tracks the value of these other activities in current and in constant ruble resources. It also shows the total value of Soviet defense in the two measures.

US Dollar Measures

The previous sections have discussed monetary measures that use prices, in rubles, based on economic conditions in the Soviet Union. Monetary measures of Soviet defense activities can also be estimated using economic conditions in the United States. The valuation of Soviet defense activities in dollars measures their size in units familiar to US audiences and permits comparison of Soviet activities with similar US activities.

Comparisons of Soviet and US Defense Activities Using Dollar Measures

Dollar analogues for any of the monetary measures calculated earlier in ruble prices could, in principle, be calculated. The remainder of this section will use only the constant resource price measure. The use of current dollars would introduce the confusion of inflation into the already difficult task of comparing two countries' activities. The Soviet notion of comparable prices is foreign to US policymakers. Of the two constant price measures, each has its attractions for comparisons of US and Soviet defense activities. The

[28] The Soviets, particularly the military, undoubtedly use measures other than monetary to summarize the flow of goods to defense. Some of these measures would show different results. For example, simple counts of the numbers of weapons being produced for the military would show declining numbers in many major categories. The military might put more weight on these declining numbers than on their increasing current ruble values.

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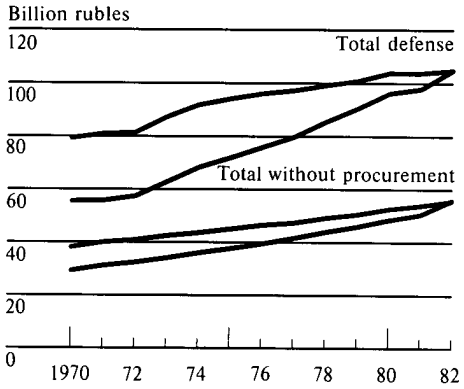
Figure 10
Soviet Defense Spending



The top two lines show the cost of Soviet defense activities measured in current rubles and measured in Western style constant resource rubles with 1982 as the base year. The bottom pair of lines show the costs of all defense activities except procurement—operations, maintenance, manning, construction, research, development and testing. The comparisons demonstrate an average inflation rate of 2 percent for the activities other than procurement and 3 percent for the total.

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constant resource measure is usually used, however, because the value of US defense activities in constant resource prices is available from Department of Defense records. The data to measure US defense activities in constant output prices have not been collected in any accessible form.

The constant dollar resource price for a good is defined to be the cost of providing the good in the United States at the prices, wages, and efficiencies prevailing in the base year. Estimating the cost of Soviet defense production using constant dollar resource prices confronts a complication not present in constructing constant ruble resource prices. The Soviet Union and the United States have different industrial bases and experiences. For example, a US aircraft manufacturer could not today manufacture a Soviet aircraft. It would first have to develop plans, identify suppliers who could begin to produce component parts, train its labor force, retool its assembly line, and so forth. Most US manufacturers could not produce on the large scale that the Soviets do without first building additional plant floorspace.

The purpose of valuing Soviet goods in dollar terms is to gain an appreciation of the size of the goods and services the Soviets are providing their military. This sizing would be overstated if the valuation also included the economic costs of transforming US industry to produce such items. Therefore, the calculation of constant dollar prices assumes that the requisite production base is in place, complete with a trained work force, qualified suppliers, and all other necessary ingredients to duplicate the Soviet output at normal US efficiencies in the base year. This assumption, however, does not exclude the usual US costs of preparing for the production of a new product.

Figure 11 compares the magnitude of total defense activities, measured in dollars, in the Soviet Union and the United States. From it one sees the abrupt increase in US activity during the Vietnam war years, followed by a decline until the late 1970s when the United States began to increase its military readiness and the pace of modernization. Throughout the period the Soviets increased their activities but at a gradually slowing rate.

Figure 12 shows the magnitude of defense procurement for the Soviet Union and the United States. From it one sees that most of the pattern shown in the comparison of total defense activities in figure 11 is explained by the patterns of procurement. The valuation of Soviet procurement shows the same pattern as the constant ruble resource valuation, even though the dollar constant resource prices are based on US manufacturing conditions. This similarity indicates the steady level of procurement since the mid-1970s is determined by the physical items procured rather than by some peculiarity of Soviet economic conditions in the base year 1982.

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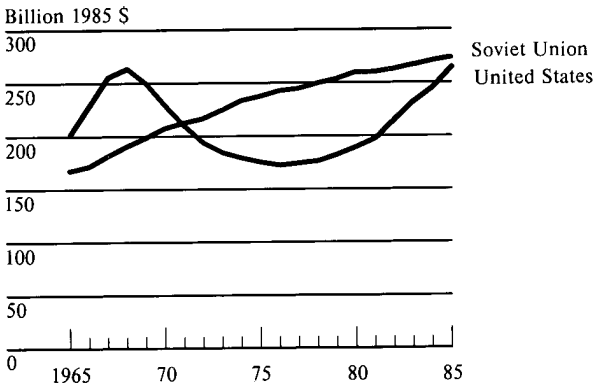
Figure 11
Cost of US and Soviet Defense Activities in Constant Dollars



The two lines compare the relative sizes of US and Soviet total defense activities as measured by constant dollar prices. The definition of total defense activities is that in common use in the United States. Comparisons in the same constant resource price base of the activities of two different countries permit conclusions about the relative magnitudes of those activities but not about the relative effort required to produce them.

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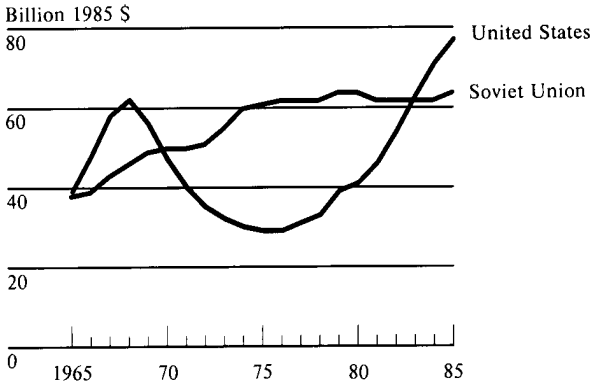
Figure 12
US and Soviet Procurement in Constant Dollars



The two lines compare the relative sizes of US and Soviet procurement as measured by constant dollar prices. The definition of procurement is that used by the United States, which differs slightly from the definition used by the Soviets. The values are shown for the years in which payments would be made to the manufacturers. The actual deliveries to organized military units take place later.

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A Special Problem When Comparing Two Countries' Activities

Comparisons of the activities of two different economies by means of a monetary measure have long concerned economists because of what is commonly called the "index number problem." The problem arises because the two economies have different resource endowments, different desires for goods and services, and different production efficiencies.[29] When deciding how to allocate their resources, leaders naturally consider these factors. Simply put, leaders base their decisions, in part, on their perceptions of both the relative benefits and the relative costs of their alternatives.

Yet, the comparison of two sets of activities requires a common measure. As a result, monetary comparisons are customarily done using the prices of one of the economies for both economies.[30] There are three important implications of this for monetary comparisons

[29] These underlying differences result in different price structures (the relative prices of goods and services) and utilities (the relative attractiveness of goods and services). The index number problem occurs both for comparisons between the economies of two countries and for comparisons of a single country's economy at different times. Indeed, the index number problem is present in all of the earlier discussions of constant resource and constant output prices.

[30] Comparisons are also made by making two preliminary comparisons, one for each economy's prices, and then averaging the results. This approach eliminates the need to decide which prices to use, but it suffers from having then done the comparisons in some unknown and uninterpretable price structure.

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Table 1
Hypothetical Comparisons of Production for Two Products

	United States		Soviet Union		Value of Production			
	Number Produced	Unit Price [a]	Number Produced	Unit Price [b]	United States		Soviet Union	
					Dollars	Rubles	Dollars	Rubles
Widgets	100	1	50	2	100	200	50	100
Gizmos	50	1	75	1	50	50	75	75
Totals					**150**	**250**	**125**	**175**

[a] US dollars.
[b] Rubles.

of US and Soviet defense activities. First, the results of the comparison will depend on which country's price structure is chosen. This point may be illustrated by a simple example. Suppose in a particular year the United States and the Soviet Union each produce a pair of identical products, widgets and gizmos, in the amounts and at the prices shown in table 1. How can the total output of the two products be compared using a monetary measure? Saying the United States had a total value of $150 and the Soviet Union a total value of R175 yields no useful comparative information. The output of both countries needs to be valued in the same units. Doing so, however, gives two different results for the two choices of currency. The value of Soviet production of these two products is 83 percent of the US value when both are measured in dollar prices but only 70 percent when both are measured in rubles. Which is correct? They both are. Similar differences occur when both countries' defense activities are compared in dollars and then in rubles—that is the Soviet Union compares more favorably with the United States when comparisons are carried out in dollar prices than when they are based on ruble prices. Comparisons completed in the United States are usually made in dollars because US leaders are used to viewing results based on the dollar price structure.

Second, when the price structure of one country is used to calculate a monetary measure of the activities of another country, a certain amount of artificial inefficiency is imputed to the other country. Soviet leaders, for example, base their decisions in part on their costs. If they were operating in the dollar price environment of the United States, they might decide they could achieve the same benefits at a lower cost by producing a different mix of products. Continuing with the simple example of table 1, consider just two mixes of widgets and gizmos that might be viewed by Soviet leaders as having the same benefit—mix A, consisting of 50 widgets and 75 gizmos, and mix B, consisting of 80 widgets and 40 gizmos. Mix A, the one the Soviets produced, has a cost of 175 rubles and mix B has a cost of 200 rubles. If the two mixes promised equal benefits to the Soviets, they would reasonably choose mix A. The dollar cost of mix A, however, is 125, and mix B has a dollar value of only 120. Had the Soviets been doing their planning in dollar prices, they would have ordered the cheaper mix B. Valuing actual Soviet production in dollars has the effect of making Soviet decisions appear less efficient. It is in this sense that it is sometimes said that valuing one country's activities in another country's currency exaggerates their value.[31]

[31] Measuring the degree of this artificial inefficiency when valuing Soviet defense activities in dollars is not possible without knowing the Soviet leadership's benefit calculus. Measurements that assume such calculus can be estimated empirically—by calibrating the so-called linear expenditure system of utilities to fit observed Soviet decisions and prices—suggest the inefficiency is no more than 5 percent.

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Third, when the price structure of one country is used to value the activities of another country, a certain amount of artificial benefit is imputed to the other country. Consider again the simple example of table 1. US leaders would have some impression of the benefit the United States would receive from $125 worth of widgets and gizmos—the dollar value of actual Soviet output. They might appraise the relative benefits of widgets and gizmos differently than the Soviets. They might perceive mix C, consisting of 70 widgets and 45 gizmos as being just as good as the actual Soviet mix. But mix C could be obtained for only $115. To say, then, that the dollar value of the Soviet output is $125 is to add $10 worth of implied benefit from the US perspective.[32]

The preceding discussion of the index number problem serves as a warning not to use monetary comparisons of activities in two countries without careful consideration of whether the measure being used is suitable for the question at hand. It should not be interpreted as saying that the dollar measures of Soviet defense activities have a built-in bias toward overstatement. Assuming there are no errors of estimation or calculation, dollar measures measure precisely what they purport to measure. It is only their improper use that may bias understanding.

Suggested Guide for Using Monetary Measures

The purpose of summarizing is to highlight trends and relationships not readily perceived from the details. Any summary measure of complex activities must, however, eliminate the richness of that detail. The paper has presented the major monetary measures used to summarize Soviet defense activities. This section gives general guidance for when each should be used. There can be, however, only one absolute rule. The best measure is the one that best extracts from the data the answer to a particular question.

There are two perspectives to consider. The USSR and the West have different economic systems and view economic relationships differently. For example, the evolution of Soviet statistical practices has led the Soviets to adopt the notion of comparable prices as a measure of output. As discussed above, this measure does not eliminate the effects of inflation and exaggerates growth. It is hard for the Soviets to develop a better measure, however, without acknowledging officially that the hidden inflation exists in defiance of their edicts. The West has no such inhibition and can construct constant resource or constant output price measures with or without adjustments for factor costs. The West, on the other hand, is hindered in constructing its measures of Soviet defense by the unavailability of much of the data its methods require.

The two perspectives could offer different answers to the same question. When evaluating Soviet activities and their economic impact, there is an advantage in using the Western perspective because it presents the best understanding in economic terms.[33] When attempting to understand Soviet decisions or perceptions, the Western viewer should use the Soviet perspective because it estimates what the Soviets themselves see.

The remainder of this section presents questions frequently asked about Soviet defense activities. Each question is followed by a discussion of which measures should be used in seeking answers. For many of the questions, monetary measures alone are not sufficient to provide a complete answer. Other measures—physical quantities, combat effectiveness, and the like—should also be used. This section addresses only the portion of the answers involving monetary measures. Table 2 summarizes the recommendations.

How Much Have the Soviets Been Spending on Defense?

Current ruble measures are best suited for this basic question about the actual annual outlays for defense. They represent the amounts the Soviets show on their books and are the basis for all other ruble-based measures. Because of the distortions in the Soviet

[32] This effect would merely restate the previous inefficient dollar argument in the implausible case that the leadership in the two countries share a common perception of the value of different combinations of widgets and gizmos.

[33] The Western perspective often requires using ruble measures. The difference in perspective is defined by differing economic concepts, not currencies.

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Table 2
A Summary Guide to Choosing an Appropriate Measure

Question	Point of View	
	Soviet	Western
How much have the Soviets been spending on defense?	Current ruble prices	Current ruble prices
What are the trends in Soviet defense spending?	Comparable ruble prices	Constant ruble resource prices
What are the trends in the volume of goods going to Soviet defense?	Comparable ruble prices	Constant ruble output prices
What has been the impact of defense on the Soviet economy?	Comparable ruble prices	Current or constant ruble resource prices at factor cost
What are the trade-offs between defense and the civilian economy?	Current ruble prices	Current ruble prices at factor cost
Where have the Soviets been putting their resources within defense?	Comparable ruble prices	Constant ruble resource prices
Are the Soviets changing their emphasis on defense or within defense?	Comparable ruble prices	Current or constant ruble output prices at factor cost
How do Soviet defense activities compare with US defense activities?	US dollar prices [a]	Constant US dollar prices

[a] Rubles would seem to be the appropriate currency. The Soviets, however, publish estimates of their national income and industrial output in dollars for comparison purposes with the United States. This practice may extend to defense comparisons also.

price system, however, knowing only the amounts spent allows limited insight into the significance of those amounts.

What Are the Trends in Soviet Defense Spending?
Trends are identified by studying the behavior of a component of defense spending over time and by comparing this behavior with that of other components. One major component of defense spending is the changing price level of defense goods and services. All the measures in this paper, except the current ruble measure, are intended to eliminate this component from their values. Other trends of interest include examining procurement patterns over time and the relative allocation of either resources or output to the various services or military missions.

If the trend in the price level is at issue, the comparison of a current ruble series with a series in constant rubles provides an estimate of the changing price level. The constant ruble measure is then used as a basis for identifying trends in the level of activities within defense. The proper constant price measure to use depends on the desired perspective. The Soviets use comparable rubles. As discussed above, this measure is seriously flawed but shows how the Soviets might view trends in their military programs. Western experts generally agree that outlays in constant ruble resource prices are the proper choice from a Western perspective.

What Are the Trends in the Volume of Goods Going to Soviet Defense?
Measuring the changing volume of goods requires assigning to each good some unchanging number that captures its relative "volume" with respect to the other goods. Of the monetary measures, only those in comparable ruble prices or constant ruble output prices satisfy the unchanging number requirement. The Soviets use comparable rubles as a measure of

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output volume. Western experts prefer the constant ruble output measure because it excludes the inflation embedded in the comparable price measure.[34]

What Has Been the Impact of Defense on the Soviet Economy?

Because resources for defense could have been used for other purposes, one way to measure the sacrifice for defense is to estimate what might have happened had the resources instead been used in other ways. These calculations are best done by modeling the development of an economy over time under different assumptions regarding defense spending, but in their simplest form they are done by estimating the share of the resources of some economic sector going for defense. For example, about 40 percent of the resources of the Soviet machine-building sector is used for defense. One then imagines what might otherwise have happened. From the Western perspective, the proper measures for all such excursions are current or constant resource rubles at factor cost. Current rubles are preferred for simple percentage statements because they reflect both the changing quantities and the changing prices of the physical resources required. Constant resource rubles are used by most econometric models to present relationships over time without the confusion of changing price levels. The Soviet perspective again appears limited to comparable rubles.

What Are the Trade-Offs Between Defense and the Civilian Economy?

As the Soviets plan their resource allocations, they undoubtedly consider the effects of different decisions. Much of this planning is based on physical quantities, but current rubles seem to be used for the monetary measure. Western experts prefer to use current rubles at factor cost to capture the present economic relationships unless the econometric models used require constant resource rubles at factor cost.

[34] Values in constant ruble output prices are often refined by adjusting them to reflect the factor costs of the base year. This adjustment has little practical effect on total procurement. It does change the relative shares of the different resource categories within defense, primarily increasing the shares of military pay and research, development, testing, and evaluation (RDT&E) and lowering the share of procurement.

Where Have the Soviets Been Putting Their Resources Within Defense?

Soviet defense activities may be divided into various categories according to several classification schemes. The two schemes most frequently used are the mission classification and the resource classification. The mission classification divides the activities into categories such as strategic forces, general purpose forces, and support. These categories are then further subdivided as needed. The resource scheme divides activities into procurement, operations, maintenance, military pay, and research, development, testing, and evaluation. Other schemes place activities into branch of service or geographic area. Monetary measures can help in understanding the priorities these various categories have enjoyed. Constant ruble resource prices provide the best Western measure for comparing these activities. The Soviets probably use comparable rubles.

Are the Soviets Changing Their Emphasis on Defense or Within Defense?

The degree of emphasis on defense is usually measured by examining the shares of the output of the Soviet economy and of its key sectors, such as machine building, which are dedicated to defense activities. Within defense, relative emphasis is usually measured by comparing the shares of defense resources going to the components of interest. In either case, the proper Western measure of emphasis depends on whether one is interested in what the Soviets are willing to pay or in what they are actually providing to the military. Current ruble prices at factor cost is the appropriate measure for the former, constant ruble output prices at factor cost for the latter. The Soviets probably use comparable rubles for both.

How do Soviet Defense Activities Compare With US Defense Activities?

Western experts use constant US dollars for these comparisons. US data are available in dollars, and Western policymakers are used to thinking in dollar terms. For similar reasons, the Soviets should make such comparisons in rubles.

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Is the Soviet Union Getting More for Its Defense Money Than the United States?

This question cannot be answered using only monetary measures. Two different kinds of measures are required: one to measure the utility or value of what is being obtained, and the other to measure its cost. Monetary measures can serve only to measure cost. Even then, because the United States and the Soviet Union have different economies and different resource costs, it is not clear that any one monetary measure can fairly represent the comparative costs of defense to the two countries.

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Appendix A

Glossary

Administered price system
A system in which the prices are set by government officials instead of by market forces reflecting supply and demand.

Base year
A year chosen to be a reference year for some purpose. For example, 1982 is the base year for many of the prices used in this paper—meaning prices for items produced in other years are based in some sense on the conditions prevailing in 1982. A particular year is often chosen to be a base year because it is believed in some sense to be "normal." For the Soviet Union, 1982 is chosen because a major price revision was held in that year.

Capital
Those things used to make something else. Capital may be thought of in two categories: fixed capital—machinery, buildings, and plants—and working capital—inventories of raw materials, semifinished goods, components, and money.

Comparable rubles
A concept used in the Soviet Union to value output.

Constant output prices
A concept used in the West to assign a constant value to each item of a particular product no matter when it was produced.

Constant resource prices
A concept used in the West to assign a price to an item based on the physical resources used to produce it.

Constant dollar prices
There can be many meanings for this ambiguous term. As used in this paper, constant dollar prices are constant resource prices. When calculated for a Soviet good, the price is based on the constant dollar costs in the United States to provide the resources required in the United States to produce the Soviet good.

Cost
The price paid to produce something. Costs include raw materials, wages, maintenance, utilities, machinery, and other overhead expenses.

Current rubles
The amount of rubles actually paid for something.

Defense activities
All of the things done in direct support of the military establishment. Defense activities include the procurement of weapon systems and military equipment, military construction, the acquisition, training, and support of military personnel, the operating and maintenance of the armed forces, and military research, development, testing, and evaluation.

Enterprise
The basic manufacturing unit in the Soviet Union, roughly comparable to a medium-sized corporation in the United States.

Established price
A Western term for an administratively set price in the Soviet Union.

Factor cost
A concept used in the West to assign a value to output based on the costs of the factors of production—land, labor and capital—used to produce it. Factor costs may be calculated on either a current or constant basis.

GNP
Gross national product. The total value of a country's annual output of final goods and services plus residents' income from economic activity abroad less the income of nonresidents in the country.

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Laspeyres price index
A measure of price levels, proposed by Etienne Laspeyres in 1864, based on the changing prices for a fixed set of quantities. The index for a given year is the ratio of the value of the quantities in the given year's prices to the value of the same quantities in the base year's prices. The fixed set of quantities is usually taken as the actual quantities of the base year. The formula for a Laspeyres price index for the year y is:

$$I_y = \frac{\Sigma q_b p_y}{\Sigma q_b p_b}$$

where b represents the base year, q represents the quantity of a particular good, and p its price. A Laspeyres price index with a late base year is often incorrectly called a Paasche price index, because it is erroneously thought that the base year must be an early year of a series. The base year, however, may be any year.

Learning curve
A mathematical representation of the cost reduction experienced as a plant continues to produce an item. There are two forms of the learning curve in common use—the cumulative average form and the unit form. Both use the same two parameters: **A**, which is the cost of the first unit produced, and **L**, which is called the degree of learning.

For the cumulative average form, $1 - \mathbf{L}$ is the amount the average cost of all units produced is reduced as the number produced is doubled. In other words, if **n** represents a certain number, the ratio of the average cost of the first **2n** units is equal to **L** times the average cost of the first **n** units. In formula terms the total cost of **n** units is: $T_n = \mathbf{A} \times \mathbf{n}^{\frac{\log \mathbf{L}}{\log 2}+1}$, and the cost of the **n**th unit is: $T_n - T_{n-1}$.

The definition of the unit form is similar, but it does not use averages. For the unit form, the cost of **2n**th unit is equal to **L** times the cost of the **n**th unit. In formula terms, the cost of the **n**th unit is:

$$U_n = \mathbf{A} \times \mathbf{n}^{\frac{\log \mathbf{L}}{\log 2}}.$$

Manufacturing technologies
The technologies embedded in the machinery and mechanisms of manufacturing as opposed to the technologies of the items being produced.

Marginal value
The added value obtained by acquiring one more unit of something. Unlike its usual meaning in this paper, value in this context refers to utility or true economic gain. In this context, the value of an item would not necessarily be its established price.

Normalized
Set to some standard. For example, to normalize a value series to some fixed number in a base year one would multiply each term in the series by the ratio of the fixed number to the original value of the base year.

Opportunity cost
The value forgone by not applying resources to an alternative use. The resources used to provide some good or service could have been diverted to some other use. The opportunity cost of applying them as they were is the value of this alternative use. Usually there are many alternative uses, each providing its own valuation of the opportunity cost.

Overhead
A general term covering those costs of production—such as management, plant and equipment—that do not vary directly with the amount of goods produced.

Paasche price index
A measure of price levels, proposed by Hermann Paasche in 1874, based on changing prices and quantities of things. The index for a given year is the ratio of the value of the given year's quantities in the given year's prices to the value of the given year's quantities in the base year's prices. Unlike the Laspeyres price index, the quantities used for different years in a series will be different. The formula for a Paasche price index for the year y is: $I_y = \frac{\Sigma q_y p_y}{\Sigma q_y p_b}$, where b represents the base year, q represents the quantity of a particular good, and p its price.

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Permanent price
A price assigned a product in the USSR after its first, or temporary, price expires. In some cases the permanent price may be identical to its first price. In other cases, particularly for weapons and military equipment, the permanent price may be reset each year.

Price index
A series of values representing the changing level of prices over time with respect to the price levels prevailing in a base time period. There are many possible ways of constructing a price index. In 1922, Irving Fisher published a compilation of 134 formulas that had been used or suggested for constructing price indexes.

Price level
The "average" price for a fixed product group. Price levels are almost always used and measured in a relative sense; for example, the price level for 1982 was 5 percent higher than for 1981. Price level changes occur only when prices change for a product; they do not occur for a new or modified product unless that products price is "out of line" with similar products. Price levels are usually measured with price indices.

Price reform
A change in the principles by which prices are administratively set. A reform is usually undertaken to achieve some policy purpose such as removing subsidies. For example, the Soviets reformed their industrial wholesale prices in 1967 to include capital charges. This reform, among other things, put the prices of military weapons on the same basis as other industrial products. (See also "price revision.")

Price revision
A revision or respecification of administratively set prices, usually to achieve some policy purpose such as encouraging or discouraging the use of various types of products. For example, the Soviets instituted a major price revision for industrial wholesale prices in 1982 and for construction prices in 1984. Minor revisions occur frequently. (See also "price reform.")

Product group
A group of products that have similar functions and characteristics; for example, fighter aircraft or medium tanks.

Productive factors
The prime factors of production—land, labor, and capital.

Productivity
The output produced per unit of input. Productivity is an illusive concept usually represented by some statistic—for example, value of output per labor hour.

Profit
The difference between revenue received and costs incurred. In the USSR, profit rates are usually planned in terms of percentages of costs or of the value of fixed and working capital. The planned rate for a branch of industry will be based in part on policy objectives. Actual profits may differ from those planned for a variety of reasons, some of which are discussed in this paper. In the USSR, excess profits do not enrich private shareholders. Instead profits are distributed as contributions to the parent ministry and state, capital for plant investment, bonuses paid to management and labor based in part on meeting or exceeding quotas, and funds for worker housing and benefits.

Profit margin
Profit expressed as a percentage of costs.

Series
A sequence of numbers for consecutive time periods. For example, an annual value series for defense procurement would give the value of procurement for each of a consecutive number of years.

Temporary price
The price first set for a product in the USSR.

Value
As generally used in this paper, the value of single item is its price. The value of a collection of items is the sum of the individual values of the collection. Value takes the same modifier as the prices used in calculating it; for example, if the prices are all in constant resource rubles then the value would also be in constant resource rubles. (See "marginal value" for a different usage of value.)

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Table 3
Data for a Hypothetical Production Enterprise Producing Similar Products A, B, and C

Year	Annual Numbers Produced [a]				Current Values [b]				Comparable Values [b]			
					Unit Prices			Total Value	Unit Prices			Total Value
	A	B	C	Total	A	B	C		A	B	C	
1	240	10	0	250	24.54	70.47		6,594	24.54	70.47		6,594
2	245	50	0	295	24.69	52.82		8,690	24.54	70.47		9,536
3	250	150	0	400	25.07	44.81		12,989	24.54	70.47		16,706
4	250	200	0	450	25.60	41.71		14,634	24.54	70.47		20,229
5	250	230	0	480	26.26	39.84		15,728	24.54	70.47		22,343
6	0	240	10	250		39.52	111.39	10,620		70.47	85.07	17,764
7	0	245	50	295		39.77	85.07	13,997		70.47	85.07	21,519
8	0	250	150	400		40.37	72.16	20,917		70.47	85.07	30,378
9	0	250	200	450		41.23	66.31	23,570		70.47	85.07	34,632
10	0	250	230	480		42.29	64.16	25,329		70.47	85.07	37,184

[a] Units.
[b] Rubles.

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Appendix B

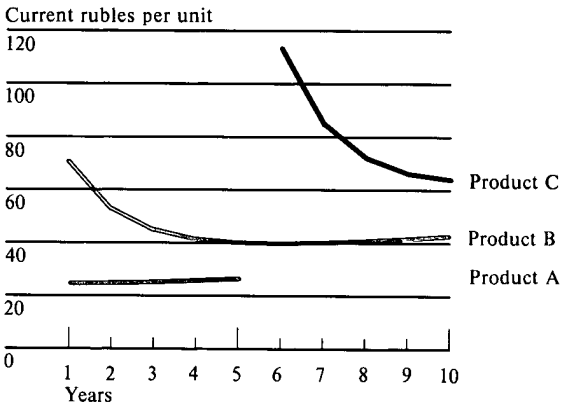
An Example of How the Comparable Price Measure Overstates Growth

In this appendix, we construct a hypothetical example of how pricing practices in defense production can lead to exaggerated measures of growth in output. Table 3 presents data covering a 10-year period for a defense industrial enterprise in the Soviet Union. Three products are produced during this period. Each product is in production for 10 years, experiences the same degree of cost reduction from learning, is subject to the same amount of cost inflation, and requires the same physical resources to produce at a given point on its learning curve. The only difference among the products is in the year each enters production. Figure 13 provides a graph of the current price profiles over time for the three products. For this example, the effect of learning on production costs dominates in the early years of production while inflation in the prices of inputs becomes the primary factor as the effects of learning diminish.

Because the products are assumed to be equivalent except for their starting date, a suitable measure of output growth should assign identical weights to each. For this simple case, the total numbers produced are a good measure of changing output. The comparable prices in year 1—the base year—for the three products, however, are 24.54, 70.47, and 85.07 rubles.[35] As a result, the output of, say, year 6 has a much higher comparable value than the output of year 1, even though the same number of items are produced in each year, with one product having five years of cost reduction from learning and another having 10 years (see figure 14).

[35] The 24.54 and 70.47 ruble values are the prices in effect in year 1, the base year. The figure of 85.07 is the price of product C in its second year of production, year 7. It can be argued that because the base year is also the first year of production for product B, its comparable price should be 52.82 rubles, or the price for its second year of production. Soviet practice in such a case is not well understood in the West. It may even be that the Soviets would use the first production year's price of 113.49 rubles for product C. The choices shown in the example, however, are believed to reflect Soviet intentions for comparable prices, and the bias occurs no matter which of the preceding interpretations is adopted.

Figure 13
Unit Prices for Three Products



The three lines show the annual prices in current rubles for three hypothetical Soviet products for defense. Product A begins its production five years before the period reflected in the figure. Product B begins production at the start of the period and product C in the sixth year. Each of the three products has the same production profile with respect to its start date. That is, for a given year of its production run, each product has the same number of items produced and each requires the same physical resources to produce. Each product has its price changed annually to account for the reductions in resources it requires in production as offset by some of the rising costs of these resources. For this example, the resource reductions at the end of the production run are not as great as the allowed increased costs. The differences in the price profiles of the products are the result of the new product price inflation discussed in the text.

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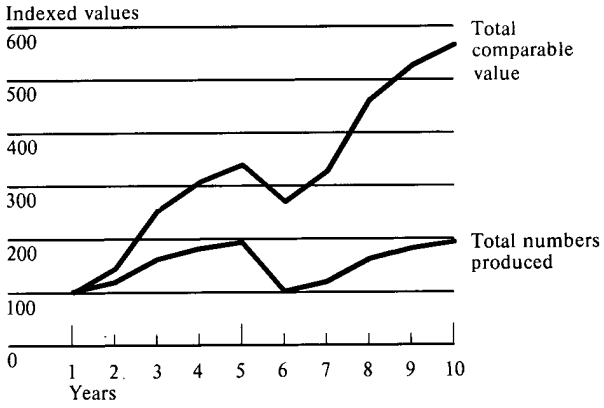
Figure 14
Two Measures of the Volume of Production



The graph shows two measures of the volume of output of three products from a hypothetical enterprise. The lower line represents the total numbers of items produced, as given in table 3, indexed to the numbers produced in year 1. As explained in the text, the three products should have equal weight in any measure of volume, so this line is a proper measure. The upper line shows the comparable value of output indexed to the comparable value of year 1. This measure assigns different weights to the products and overstates growth in the volume of output.

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A comparison of the current and comparable values of output for year 10 illustrates the misleading nature of comparable price values as a measure of changing price levels. In the 10th year, 250 units of product B and 230 units of product C are produced. They have a total comparable value of 37,184 in terms of year 1 base prices and a current value of 25,329. (This current value is also the comparable value in base year 10 prices.) The Soviets would interpret the ratio of 37,184 to 25,329 as showing a decline in price levels over the nine-year interval at an annual rate of 4 percent. Yet the example was explicitly constructed on the assumption of an allowed offset against learning of 5 percent per year and a new product inflation of 10 percent per year.

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